Momentum and Impulse (chapter 9)

Review:
Inertia - tendency of objects to move at constant speed in a straight line. Related to mass. Linear inertia = mass
rotational inertia related to distribution of mass

Momentum - Newton - quantity of motion
the product of mass and velocity
inertia in motion
symbol, p (why p? m was taken- theory - pneumatics - air motion and air pressure)

p=mv
Momentum is a vector - include direction.
units: kgm/s sometimes: Ns
N=kgm/s^2 so a Ns = kgms/s^2 =kgm/s

eg A tanker has lots of inertia but if it is not moving, it has no momentum

Impulse
a change in your motion, caused by an unbalanced force

F_{net}= ma a=Δv/Δt

$F_{net} = m\Delta v/\Delta t$ $m\Delta v = \Delta p$ if m is constant

$F_{net} = \Delta p/\Delta t$ the slope of p vs t graph = F_{net}
this is the original form of Newton's second law

$F_{net} = m\Delta v/\Delta t$ this is impulse

impulse is the change in momentum

if the F is not constant, then we determine the impulse by the area under the F_{net}-t graph

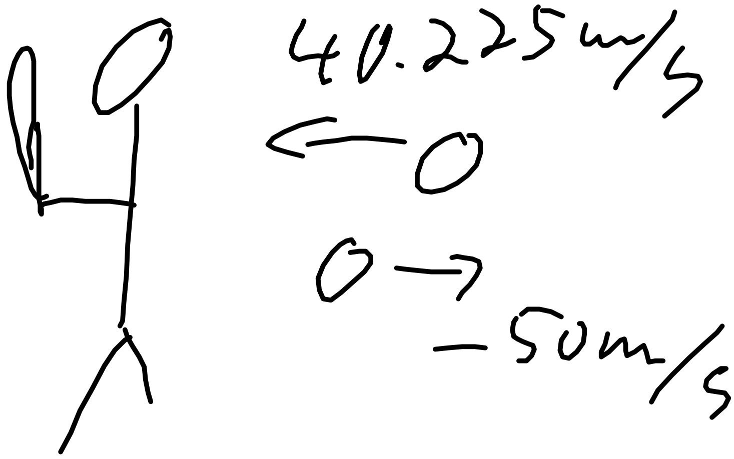
eg.

1. A pitcher throws a 0.145kg baseball at 90.0 miles an hour, 90.0 miles/hour (1.609km/mile)(1000m/km)(hour/3600s)
   90x1.609x1000/3600=40.225 m/s

The batter hits the ball back at -50.0 m/s. If the ball is in contact with the bat for 0.015s,

a) what's the momentum of the ball before and after contact?
b) what is the impulse on the ball? on the bat?
c) What is the average force on the ball over the 0.015s? on the bat?
d) keeners: sketch a graph of F vs t that is
 i) increases and decreases linearly
 ii) increases and decreases sinusoidally

a) $P_{-} = mv$



$t = 0.015\,s$

a) $p_B = mv$

$= 0.145(40.225)$

$= 5.83\,kg\,m/s$

$p_A = -7.25\,kg\,m/s$

b) $\Delta p = F_{net}\Delta t$

$\Delta p = p_A - p_B$

$= -7.25\,kg\,m/s - 5.83\,kg\,m/s$

$= -13.08\,kg\,m/s$ on the ball.

$F_{net}\Delta t_{Ball} = -F_{net}\Delta t_{bat}$ Newton's third law

$= +13.08\,kg\,m/s$ on the bat

c) $F_{net}\Delta t = \Delta p$

$-13.08\,kg\,m/s$

$$F_{net} = \frac{\Delta p}{\Delta t} = \frac{\quad}{0.0015\ s}$$

$F_{net} = -872\ N$ ball

$F_{net} = +872\ N$ bat

sketch F-t graphs
p178-180 practice problems
1-4, Concept Review 1.1-1.4